Reading Research for Undergrads
A Workshop

Emma McKay

emma.m.mckay@gmail.com
femphys@gmail.com

December 5, 2018

Introductions

- Name
- Year, Program
- What do you want to learn today?

Goals

Learn useful information about

- the purpose of academic publishing & reading research
- the mechanisms of academic publishing
- journals, reputation, and the arXiv

Develop skills for

- finding and searching a field of interest for neat research
- conducting a literature survey for a specific research topic or question
- reading papers effectively
- keeping track of papers you've read using a citation manager

Academic Publishing: What's it for?

- two goals:
    - peer review
    - formal recorded communication network
- individual researchers
    - access journal articles for information
    - participate in communication
    - contribute articles
- publishing is the main recognized method of contributing to science
    - $\Rightarrow$ *publish or perish*
    - lots of other ways to contribute: conferences, discussions, outreach, etc.
- knowing the literature $\approx$ knowing the research landscape

$$published \neq right!$$

Academic Publishing: How does it work?

- researchers have a question! they explore it.
- results, context, and method are written up.
- post the write up on the arXiv and submit to a journal.
    - submitting to many journals costs money–[\$0,\$2000]
- journal sends the draft to referees, who send comments and (dis)approval to authors
- article (often) gets published
- other researchers hear about the work through the journal, the arXiv, conferences, etc.
    - access to many journals costs money, too.
    - many researchers get access through their institution
    - open access journals have higher publishing costs

Academic Publishing: Who's who?

- each journal has a research area, standard of readability, "importance" of research, and a reputation
- *Physical Review Letters (PRL)*
- *Physical Review A, B, ...*
- *Nature*, *Nature Communications*, *Science*
- the arXiv! Open access online archive.
    - fields from quantum physics to mathematics to quantitative biology
    - pre-prints generally sent to arXiv well before they are published
    - not peer reviewed but screened through a group of moderators

Skills: Finding stuff to read

Getting access to journals

UW pays for access to all major journals of science and math.
Search on campus wifi for automatic access, or go through
https://uwaterloo.ca/library/services/get-access-anywhere and log in with
your library barcode (on your WatCard).

Scrolling for academics

plenty of good twitter accts. see @femphys following for examples.
arXiv publishes lists of accepted articles every day.
SciRate adds rating and commenting to arXiv articles.

Skills: Finding stuff to read

I don't know what I'm interested in!

- browse popular science magazines for overviews of interesting work
  - e.g. *New Scientist*, *Physics Today* and *Discover* for less technical articles
  - *Scientific American* for readable, less sensational, more detailed articles
  - *Science* and *Nature* are "real" journals written for non-experts
  - follow scientists and news outlets on social media
- got a class you're real into? saw an interesting PHYS 10? cool seminar?
  - DYK the weekly physics, math, and IQC colloquia are open to everyone?
  - ask your profs, TAs, the colloquia speakers
  - search for a researcher's publications

Skills: Finding stuff to read

I have a topic to explore!

- **review papers**: huge compendiums of literature in specific fields
- write a list of relevant keywords. include synonyms & nearby topics
  - search keywords + "review" to find review papers
  - search combinations of keywords—more on searching soon
- find a relevant author: one you know, one whose name keeps popping up, one listed on a conference webpage...
  - scroll through their publications
  - look through their website
- ask profs, grad students, friends what to read

Skills: Finding stuff to read

I have a research question!

- write it out
- identify key concepts
- write down synonyms, nearby concepts, umbrella terms
- do a fancy search

Skills: Fancy academic searching

Search Engines

Google Scholar, arXiv: broad, includes non-peer-reviewed work
Web of Science, Scopus: only peer-reviewed work, includes $\#$ citations
MathSciNet: same plus classification system of math, short summaries

Skills: Fancy academic searching

Search tools:[1]

- AND combines concepts
- OR combines search terms
- () separates concepts and holds search terms together
- "search phrases"
- find multiple endings of a word with * e.g. quant* finds quantum, quantized, etc

---

[1]Thanks to Math Librarian Rebecca Hutchinson for the intro to academic searching!

Skills: Fancy academic searching

Identify your research concept:

- "use differential geometry to describe gravity in highly symmetric scenarios"
- list separate concepts: differential geometry, gravity, symmetry
- find related concepts for each, e.g. for differential geometry:
    - geometry, Pythagorean theorem, ...
- ("differential geometry" OR "geometry" OR "Pythagorean theorem") AND ("gravity" OR grav*) AND (symmetr* OR spherical)

> try it! use two search engines.
> take a break, too.

Skills: Knowing what's important

- short answer: it's tough.
- if you find it interesting, consider it important.
- can use the number of citations as a *loose indicator*
    - this number goes up with time
    - differs between databases
    - citations $\neq$ endorsements
    - who gets cited depends on who they are. Women receive 10% less cites than men.[2][3]

what's interesting is not static

---

[2] *Nature News.* "Men cite themselves more than women do." (2016)
[3] *Nature News.* "Machine learning algorithm quantifies gender bias in astronomy." (2016)

Skills: Knowing the structure of a paper

Formal structure

- abstract: the whole thing but short
- introduction: lit review, context, motivation, outline
- body: experiment, calculations, the details
- conclusion: restate motivation & results, impact on field.

Content

- context & motivation: why and where did this come from?
- problem
- assumptions
- method
- results
- conclusions: consequences? where does result fit?

Skills: General reading strategies

know how you like to read: paper or screen?

Mendeley/on screen readers: read anywhere, make notes
physical copy: easier for many. carry pens + sticky notes with it!

Skills: General reading strategies

Goal: understand the content of a paper.

- read through two - three times.
- underline what you don't understand. be specific.
- write thoughts down as you read. be honest and critical. use stickies.
- check with yourself for understanding.
- identify and make succinct notes of:
  - main problem/question
  - assumptions made
  - results
  - important conclusions
  - issues you have
  - questions/resources to pursue further

Skills: Avoiding rabbit holes

when you don't understand a concept/term:

- first read: note what you don't get. be specific.
- second read: note what the concept is used for. is it mentioned for context? used in a proof?
- search concept in wiki/wolfram.
- identify *what* the concept is e.g. lin alg definition, name of theory...
- is this enough to move on with the paper?
- if no, keep exploring until yes OR your goal changes e.g. "time to read a QFT textbook"

Skills: Reading with a goal

I'm new! I want to learn everything!

- read review papers
- be wary of rabbit holes: concepts, references
- focus on intro & conclusion
- try mapping key concepts and papers out visually

I'm new! I want to understand a specific paper.

- ask: why does this paper matter to you?
    - is it the method? the theory? the results?
- talk about it
    - esp with a supervisor. ask for feedback on your understanding.
    - discuss how the result fits in the larger picture

Skills: Reading with a goal

I'm not new, but I don't have a specific question. I'm starting to construct my own research landscape. I want to get good at asking questions.

- make notes on how papers connect to one another
- focus on assumptions. contrast and compare.
- write down any and all questions!! ask people around you!
- fall back on basic question strategies:
    - challenge assumptions made
    - why does the result matter?

Skills: Reading with a goal

I'm not new & I have a specific research question.

- congrats hot damn good job!!
- identify what area you think the paper will help you in
- write out specifics of how it does or doesn't

Skills: Surface versus deep learning

Surface learning

superficial, takes things for granted, can be strategically used

Deep learning

the goal, often hard, incorporates knowledge into your worldview

Skills: Maintaining a library

- so you have a million papers to read!
- don't forget why you wanted to read them in the first place!!

Citation managers

Save citations, save papers, make metanotes, highlight, use stickies
e.g. Mendeley, Zotero, EndNote

- make meta notes:
    - why did you save the paper?
    - how did you find the paper?
- organize by subject and/or purpose

Review

Academic publishing: peer-review, communication network, research landscape

Searching skills: academic scrolling, seminars/speakers, keywords, review papers, fancy searching

Reading skills: paper structure & content, reading strategies, avoiding rabbit holes, know your reading goal, develop questioning, surface vs. deep learning

Tracking skills: use a citation manager, make a habit of making meta notes

practice!

Many thanks to:

- the library
- Achim Kempf
- Eduardo Martín-Martínez
- Fiona McKay
- y'all!!